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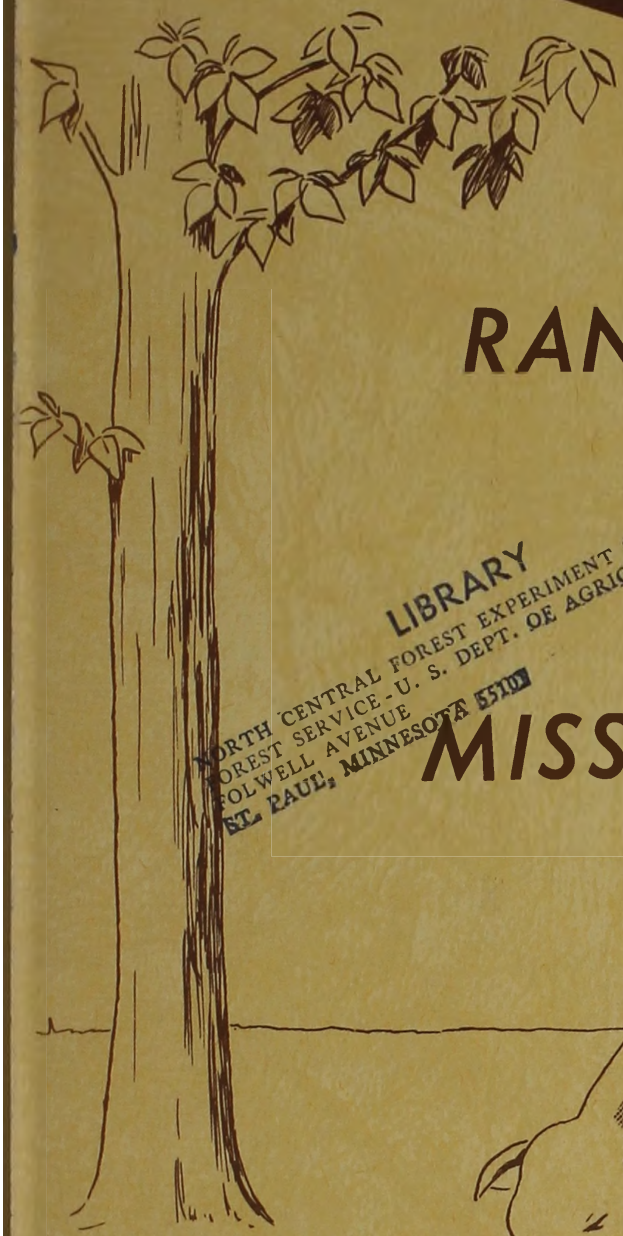

RANGE PROBLEMS in the MISSOURI OZARKS

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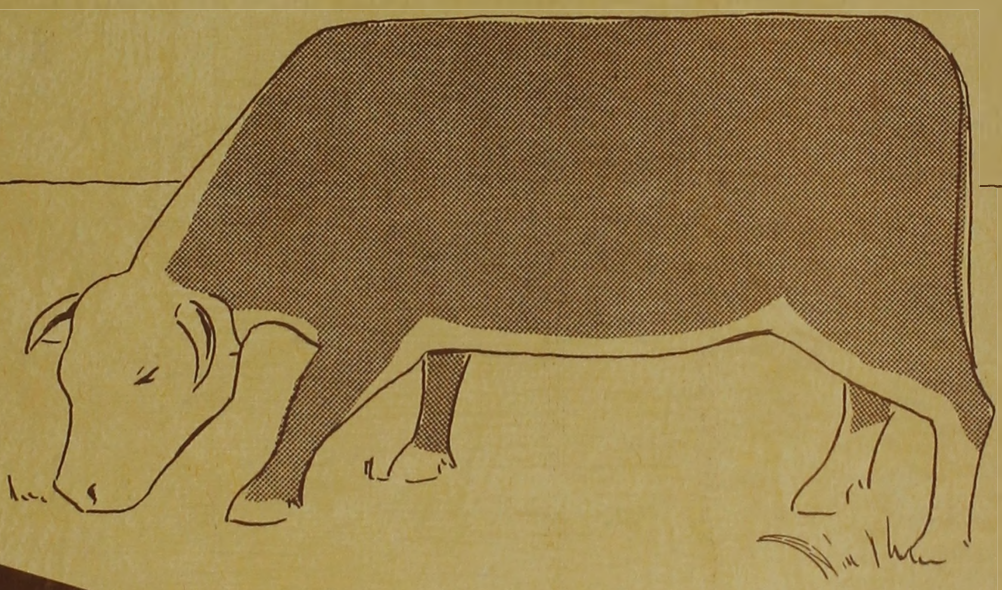

S. Clark Martin

CENTRAL STATES
FOREST EXPERIMENT STATION

COLUMBUS, OHIO

W. G. McGINNIES, DIRECTOR

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RANGE PROBLEMS ASSOCIATED WITH LIVESTOCK PRODUCTION IN THE MISSOURI OZARKS

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RANGE PROBLEMS

in the

MISSOURI OZARKS

S. CLARK MARTIN, Range Conservationist

GENERAL DESCRIPTION AND BACKGROUND INFORMATION

The purpose of this analysis is to describe the major problems associated with range livestock production in the Missouri Ozark Region and to outline a program of range research to solve those problems. To a large degree the major problem of the Ozark range user is low income. But, most of Missouri's ranges are also forests. So when the range stockman tries to increase his income by such practices as burning and goating he crosses swords with the conservationist and especially with the forester. The overall objectives of this range research program are to help the farmer increase his income and to help resolve this land-use controversy.

In January, 1955, there were more than 1,000,000 cattle and 400,000 hogs on about 75,000 farms within the 39-county area shown in figure 1. In this 17-million-acre Ozark Region the average farmer has only 13 cattle and 6 hogs but 87 percent of the total value of reported farm sales is from livestock and livestock products. Part of this livestock income is derived from "range" livestock operations.

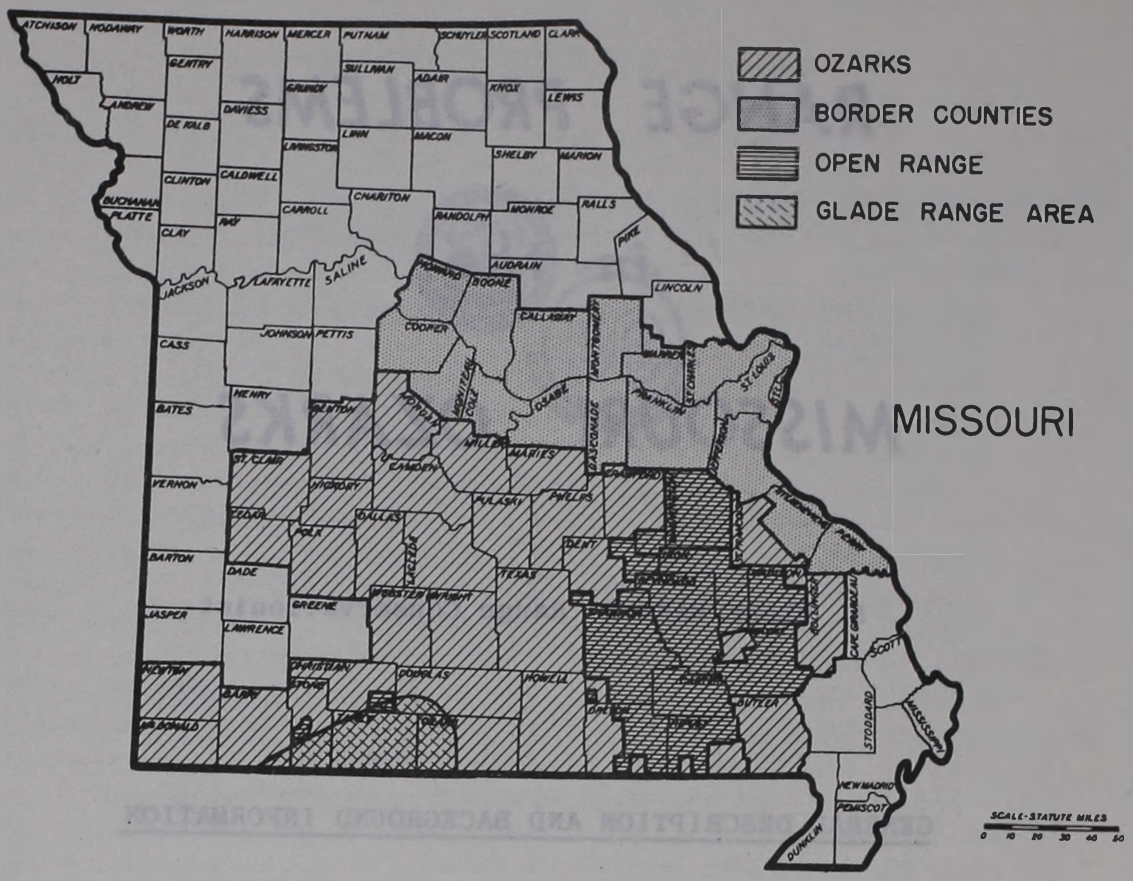


Figure 1.--Map of Ozark area showing open and closed range and location of the Glades. Statistics in text do not include the border counties.

Much of the land in the Ozarks is rough and relatively infertile. Yet the average Ozark farmer actually controls a smaller acreage than the average Cornbelt farmer on more productive land. To some extent the Ozark farmer makes up for his lack of good land by free use of nearby land belonging to absentee owners, large corporations, or public agencies. Even so, the income of most Ozark farmers is too low for a satisfactory standard of living.

The cleared land in the Ozarks, about 40 percent of the total area, is not producing at its full capacity. Very little of the land is treated with manure, lime, or mineral fertilizers. And, the usual process of clearing, which consists of cutting or girdling the trees followed by several years of burning and goating, robs the land of much of its natural fertility before the first crop is planted. Much of this land is abandoned after a few years of cropping because of low yields or a losing battle with the sprouts.

The Missouri Ozark Region is a natural forest area. More than 60 percent of the land still supports a forest cover. However, because of overcutting, burning, and unsuccessful attempts to remove them, these remaining forests are only about one-fifth fully productive. Forest products account for less than 2 percent of the reported value of farm products sold. Many years of good management will be required to restore Ozark forests to full production. Hence, they cannot be expected to contribute their share to farm income in the near future. Since the relatively small acreage of tilled crops and low-yielding forests provide inadequate income, Ozark farmers run cattle in the woods.

Cattle and hogs were brought to the Missouri Ozarks from the hilly regions of Kentucky, Tennessee, and the Virginias in the early 1800's by some of the first settlers. The abundant deer, whose browsing undoubtedly helped keep down tree reproduction before settlement, were gradually killed out and replaced by cattle. It is reported that at first the forests were rather open; were composed mostly of old, mature trees; were notably free of tree reproduction; and that fairly heavy stands of native grasses occupied the ground beneath the open forest canopy. Also, certain areas, now dominated by hardwoods, were then predominately pine. The big trees, especially pine, were the first to be cut off. In time farmers noticed that much of their grassy range was growing up to tree reproduction and that the grass was becoming thinner. They noticed, too, that burning would help maintain a grass cover by temporarily releasing the grass from woody plant competition. Periodic burning became an accepted range maintenance practice.

During recent years the federal and State conservation programs have stimulated interest in forestry and better land use in the Ozarks. Since forest improvement and proper timber management were impossible without adequate fire control, the U. S. Forest Service developed a vigorous fire-control organization to protect Federal land. Another 6 million acres of State and private forest land are now protected from fire by the Forestry Division of the Missouri Conservation Commission. Since adequate fire control is the first goal of the foresters and since control of brush and tree reproduction by periodic burning has long been an established range maintenance practice, range and forestry interests frequently conflict. As the effectiveness and scope of fire-control programs increase, the acreage of vigorous, dense tree reproduction increases and forage production decreases. Consequently, forage yields and livestock numbers have declined steadily on all forest ranges where periodic burning has been prevented.

SUITABILITY OF THE OZARKS FOR RANGE-LIVESTOCK PRODUCTION

Viewpoints and Definitions

Proper grazing and overgrazing mean different things to different people. At present the predominant viewpoints concerned with grazing use in the Ozarks have been those of the farmer or range stockman and the forester. Neither is fully cognizant of the needs of range forage plants. The stockman is interested primarily in harvesting rather than in growing forage. The forester is interested mainly in growing trees. A third viewpoint, that of the range manager, is needed to insure sustained forage and livestock production without undue conflict with forest management.

To satisfy the range manager, grazing must be light enough to provide for adequate soil protection and for maintenance or improvement of the forage but heavy enough for efficient sustained livestock production. Such a degree of use will often be too light to suit the farmer because full use of relatively unpalatable species cannot be obtained without overgrazing preferred species. Most Ozark stockmen do not realize that a certain amount of herbage must be left to insure sustained forage production and feel that any unused forage represents waste. To the forester, overgrazing usually means browsing or trampling damage to trees. However, since herbaceous plants, not trees, are the preferred forage for cattle, serious widespread damage to tree reproduction rarely occurs except where grazing use has been heavier than would be considered proper for either good range management or efficient livestock production.

"Range," as used in this paper, means any piece of land where livestock can be maintained, grown, or fattened primarily on uncultivated native forage. The term applies to any area that supports usable native forage regardless of whether the carrying capacity is low or high, whether the tract is large or small, fenced or unfenced, cleared or uncleared, or whether it is legally classified as "open" or "closed" range.

Another term, "good land use," is used here to mean any use which is satisfactory to the landowner and which will not impair future productivity of the site. Because it is a less restrictive term than "best land use," "good land use" is considered to be the more practical immediate objective for raising living standards and improving land use in the Ozarks. "Range"-livestock production is considered to be "good land use" if it returns a profit and maintains or improves the condition of the land.

Most of the Ozark Region is or has been forested and forestry undoubtedly is the most productive use for much of the area. However, forestry holds little incentive for the farmer who has a run-down woods that won't produce a worthwhile timber crop for 10 or 20 years. Failure of the forest to satisfy the economic needs of its residents has caused the farmer to convert forested land to pasture, tilled crops, or to range.

It is assumed that there are several "good" uses for many Ozark lands. And, since 90 percent of the land in the Ozarks is owned and managed by private individuals, it is assumed that "good land uses" that provide immediate economic advantage are most likely to be adopted.

Topography

The topography of the Missouri Ozark Region varies from slightly rolling to very rough. The roughest areas lie adjacent to and along the tributaries of the Osage, Gasconade, White, Meramec, Current, Jacks Fork, and Piney Rivers. Although the difference in elevation between the ridgetop and stream bottom seldom exceeds 1,000 feet, many slopes are so steep that the ridges and stream bottoms are grazed excessively before the forage on the slope is used. Perhaps a third of the area within the Ozark Region is rough enough to be inaccessible for practical cattle grazing.

Soils

Soils, classified as marginal for tilled crops, occupy about one-third of the Ozark Region. Almost two-thirds of the area is considered submarginal. The marginal soils include Clarksville gravelly loam, Lebanon silt loam, and Hanceville silt loam. These soils are mostly free of large stones and not too rough for close-drilled crops or for improved pasture. However, their value for tilled crops and forestry is limited because the topsoils are shallow and the subsoils have undesirable characteristics. Natural fertility is relatively low, and lime and mineral fertilizers are necessary to grow good pasture or tilled crops.

Most of this marginal crop area has been cleared. The remainder is now covered with low-grade forest stands consisting mostly of short post oak, blackjack oak, and low-quality black oak and hickory. The appearance of the present forest stands suggests that some of these soils may also be marginal for timber production. Like most other Ozark soils, these marginal soils can be kept free of woody vegetation only by persistent effort.

Clarksville stony loam occupies about two-thirds of the Ozark area and is classified as "definitely submarginal for crops." Most Ozark range operations are based on this type of land. Cultivation is impractical on most of this 7 million acres because of surface rocks, steep slopes, or both. About half of the area is too rough for efficient use as cattle range and most of it is so heavily wooded that the carrying capacity is very low.

The Clarksville stony soil area includes about 500,000 acres of land in the White River drainage in southwest Missouri which differs from the typical Clarksville stony loam in that the soils are much more shallow, are comparatively free of chert fragments, and the natural cover is grass instead of trees. These areas, known as the "glades," are characterized by frequent horizontal sandstone or limestone outcrops or ledges. The soil is too thin and rocky to till and is too shallow for all but the most drought-tolerant trees. These natural grass areas are potentially the best and most permanent range land in Missouri.

Climate

In the Ozark Region, mean January temperatures range from 30 degrees F. at Columbia in the northwest to 36 degrees F. at Poplar Bluff in the southeast. Mean July temperatures range from about 78 degrees F. in the north and west to about 80 degrees F. in the south and east. The average frost-free period is 180 days--long enough for ample range-forage production.

The Ozarks generally enjoy slightly milder winter temperatures and slightly cooler summer temperatures than the adjacent plains. Although short periods of sub-freezing cold are common, range forage is rarely covered with snow or ice for more than 2 or 3 days at a time. Almost every winter has several periods of mild weather. Ozark winters are neither too long nor too severe for range cattle.

Annual precipitation in the Ozarks ranges from 36 inches in the north to nearly 50 inches along the Missouri-Arkansas border. At Poplar Bluff in the southeastern corner of the Ozark Region, only 60 percent of the annual precipitation falls between April 1 and October 31. Other sections of the region receive about 70 percent of their total annual precipitation during this 7-month period. The average warm-season rainfall ranges from 25 inches at St. Charles in the northeast to 32 inches at Neosho in the southwest.

All parts of the Ozark area normally receive enough precipitation to grow trees, tilled crops, or improved pasture. Nevertheless, there are sites in the Ozarks that are too dry for such uses because the capacity of the soil to absorb and retain moisture is inadequate. Very shallow soils and very coarse-textured soils are dry soils because they have low water-holding capacities. On the other hand, bare soils, soils on steep slopes, and very fine-textured soils may be dry because too much of the rain is lost as surface runoff. South slopes are drier than north slopes because of greater insolation. Land characterized by one or more of these dry-site conditions can be too dry for tilled crops, improved pasture, or timber and, consequently, better suited for range (fig. 2). The glade area in the southwest Ozarks is the most extensive and striking dry-site type in the Ozarks.

Figure 2.--Thin soil and southwest exposure make this a typical dry site in spite of 40 inches of rainfall. It has almost no value for growing trees, tilled crops, or improved pasture but the moderate cover or perennial grasses makes it suitable for cattle range.

Vegetation

Hardwood forests dominated by oak are the prevailing form of natural vegetation in the Ozarks. Forests occur on about 10 million acres, or 60 percent of the area. Shortleaf pine occurs in varying amounts on about half of the forested land. Forests occupy all sites except those that have been cleared and those where the soil is too thin for trees to grow. On most sites, a good grass cover can be maintained only by practices that are more harmful to trees than to grass.

The predominant Ozark range grasses are prairie species. These include little bluestem (Andropogon scoparius Michx.) big bluestem (A. furcatus Muhl.), broomsedge (A. virginicus L.), side-oats grama (Bouteloua curtipendula (Michx.) Torr.), switchgrass (Panicum virgatum L.), Indiangrass (Sorghastrum nutans (L.) Nash.), purpletop (Tridia flava (L.) Smyth.), and prairie dropseed (Sporobolus heterolepis A. Gray.). Many of these grasses are found throughout the Ozarks. Where the forest cover is relatively heavy, they occur as weak, widely scattered individual plants. But areas that have been kept free of woody vegetation and protected from overgrazing support dense stands of these species.

Kinds of Livestock on Ozark Range

Cattle, horses, mules, sheep, goats, and hogs all use the forest range. Almost all of the horses and mules that use the range are draft or saddle animals that the farmers keep for their own use. Sheep and goats are raised mainly on fenced pasture for special purposes, including weed and brush control. Beef cattle and hogs are the most common producers of range income.

Of all livestock classes, beef cattle are best suited to make continued profitable use of most Ozark ranges. Beef cattle are well able to shift for themselves on the range, they can exist on low-quality range forage, and they can defend themselves against ordinary predators. Moreover, cattle fences are relatively inexpensive. Many Ozark farmers have "grown" into the beef-cattle business via the milk-cow route by saving heifer calves. For many years it was even common for the farmer to raise rather than buy his herd bulls. Consequently, the Ozark cattle of a few years back were mostly inbred descendants of inferior dairy stock with poor beef conformation and low market value. However, the quality of beef cattle is improving and the "yellow hammer" cow is being replaced by better stock. Most Ozark beef cattle are Herefords, but Angus and Shorthorn also are popular. Many herds are essentially purebreds (fig. 3A). Others are of reasonably good beef conformation but still show their dairy ancestry (fig. 3B).

(A)

(B)

Figure 3.--Good cattle have almost replaced the scrubs on Ozark range. Most range cattle in the Ozarks are Herefords (A) or "Hereford-dairy-breed" crosses (B).

In recent years there has been increased interest in dairying, particularly around the edges of the Ozarks. The movement has been associated with increased acreages of improved pasture and improved quality of livestock. However, except possibly for young breeding stock and dry cows, it is generally considered impractical to run dairy cows on native forage.

Sheep and goats appear to have no practical place on Ozark range at present because most Ozark ranges also are forests and raising sheep and goats is considered incompatible with good forestry. Young trees are especially susceptible to browsing damage by sheep and goats. Another shortcoming of sheep and goats for Ozark range is that they cannot defend themselves against roving dogs, coyotes, or other predators on open range and flocks in the Ozarks are too small to justify herding. A few sheep are raised under fence for meat and wool but very few farmers keep goats chiefly for milk or mohair. Instead, most Ozark goats are kept because their browsing habit is helpful in clearing land (fig. 4).

Range hogs are almost as common as range cattle. Because the carcass is small enough to handle, and ham, bacon, sausage, and lard are easy to preserve by common home methods, the hog is a good meat animal for home consumption. And, if the acorn crop is good, a sow will pay for herself more quickly than a cow will.

Figure 4.--To kill brush with goats requires heavy overstocking--so heavy that the goats will browse all woody species. Left, the goats are passing up sprouts to graze crabgrass and other herbaceous forage; right, the goats have eliminated the herbaceous plants but some of the tougher woody species still persist.

Since hogs feed largely on mast rather than grass, they are well adapted to much of the grass-poor range in the heavily wooded eastern Ozarks. In this area, hogs exceed cattle in number, whereas there are less than half as many hogs as cattle in the more open southwestern Ozark counties.

Despite the apparent economic advantages hogs have over cattle for the small farmer, they are not well adapted for controlled range operations. Hog-proof fences are so expensive that adequate control of hog movements on the range is practically impossible. Hog raisers probably are responsible for the present high percentage of open range in the eastern Ozark counties.

Where the land is used for cattle range or improved pasture, the rooting of hogs is objectionable. Parts of improved pastures may be almost completely uprooted and yields of native forage stands can be reduced greatly by only a few hogs (fig. 5). In the forests, hogs consume acorns and nuts and uproot seedlings. Even so, hogs will probably continue to be run in the woods for some time to come because they make a needed contribution to the living of the local people.

Figure 5.--Range hogs are especially destructive to improved pasture and can quickly convert a good stand of orchardgrass and redtop (left) into a rough, unproductive condition (right).

SOURCES OF RANGE FORAGE

In the Ozarks, distinctive range types result mainly by differences in factors that affect soil moisture content and differences in past use. When white man first came to the Ozarks, perhaps 90 percent of the area was forested although parts of the forest approached savannah conditions at that time. Since then the forested area has been changed by two opposing forces. Much original forest land has been cleared, or at least partly cleared, for tilled crops, pasture, or range. On the other hand, much of the originally open land has been partially or completely taken over by a combination of brush, scrubby hardwoods, and eastern redcedar (Juniperus virginiana L.). At present about 60 percent of the Ozark Region is in forest, 35 percent is cleared land, and 5 percent or less remains as relatively open natural grassland. These are the main sources of range forage.

Forest Range

All Ozark forest range is not alike. The amount of grass is inversely related to the density of the forest stand, and, the density of the forest stand depends largely on past use and abuse (fig. 6). With appropriate management, practically all sites will grow either trees or grass.

Ozark forest sites have been classified for forest production according to the length of merchantable bole that can be expected from mature hardwood trees. On most of these sites shortleaf pine will produce about one more 16-foot log per tree than will the hardwoods.

The best timber-producing sites are on the deeper soils on relatively moist areas. About one-fourth of the forest land of the Ozarks is capable of producing hardwood trees which at maturity will yield 2 or more 16-foot logs. Timber undoubtedly can be a paying commercial crop on such land. But even on good forest land, timber may not be a practical crop for the farmer who must have immediate income but whose timber stand is in such poor condition that he will have to wait several years for his first sale.

About 8 percent of the forest land in the Ozarks is capable of growing hardwood trees that will yield only half a log at maturity. Such land will not yield a high return in timber and there is a good possibility that much of this poor timberland will grow a paying crop of grass if satisfactory ways to control woody plants are found.

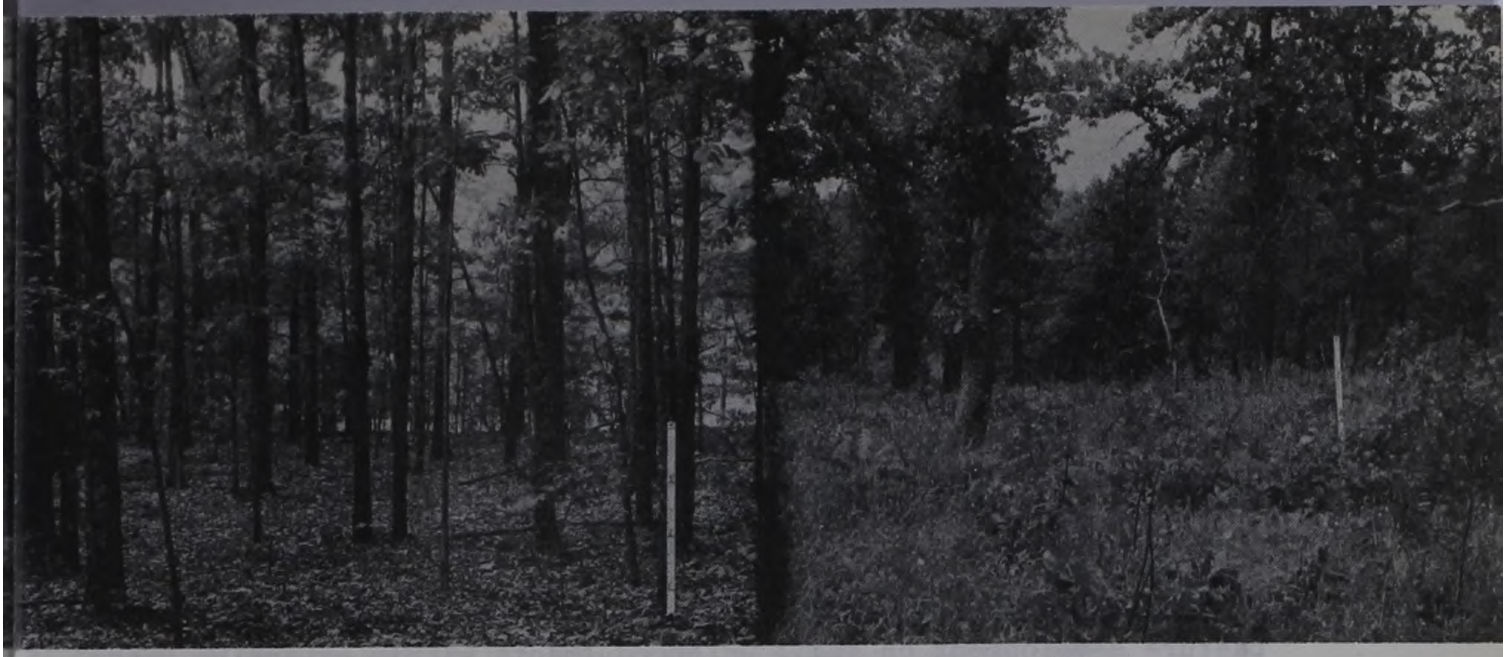


Figure 6.--Some effects of fire on timber and forage. Left, protection from fire permitted these young straight trees to develop but the ground cover is composed almost entirely of leaves. Right, annual burning has made this a forest of old defective trees and 1-year-old sprouts but there is no leaf litter to smother the grass and herbage production is relatively high.

About two-thirds of the forest land in the Ozarks is neither good nor poor. It is land that will grow hardwood trees yielding 1 to 1-1/2 16-foot logs at maturity. The best of this fair timberland borders on the good and the poorest is little better than the 1/2-log sites. It will all grow trees but on the poorer half of this fair timberland it is doubtful whether timber can compete with grass as an economic crop. The main obstacle to timber production is the long wait for the first crop. The main obstacle to grass production is the cost of controlling woody vegetation.

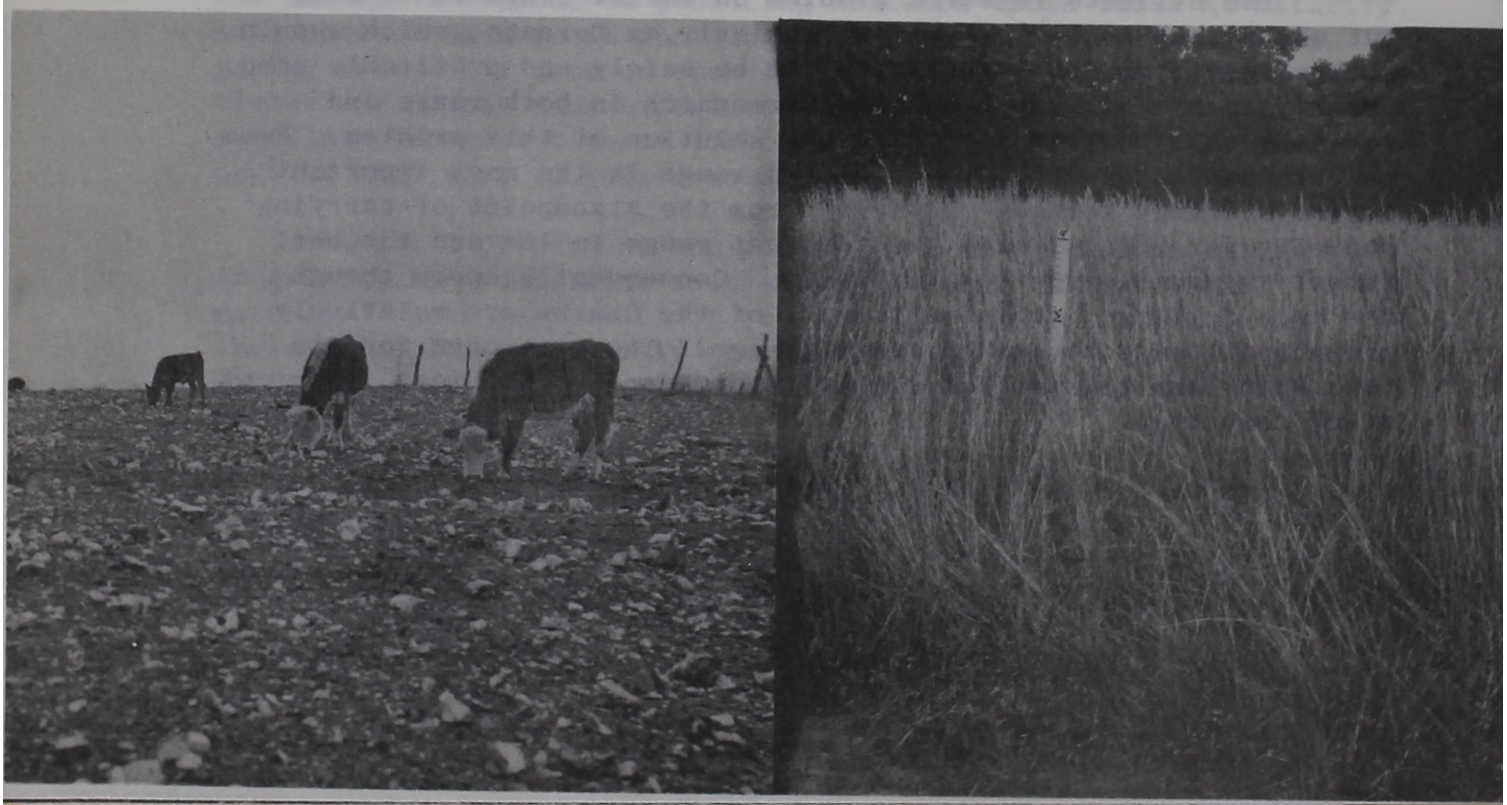
The utlimate research problem on forest range is to find out which land should be used exclusively as forests, which should be devoted to grazing, and which can be safely and profitably used for either or both. All phases of research in both range and forestry will contribute toward the solution of this problem. From the standpoint of area, the forested range is the most important source of range forage. However, from the standpoint of carrying capacity per unit of area, most forest range is low and the best forest is usually the poorest range. Consequently, even though the area is large, the good forests of the Ozarks are relatively unimportant as a source of range forage. The more open forests that show less promise for timber production are the most important sites for range.

Old Fields

Old fields and other clearings occur on a variety of sites. Most of the better cleared land is devoted to cultivated crops or in improved pasture, leaving only the poor or remotely located fields to native vegetation (fig. 7). Most of this land will grow some native grasses but the natural cover that develops when cultivation stops usually constitutes very poor forage. Even so, the old fields, roadsides, and other uncultivated clearings produce an important part of the range forage in heavily wooded areas. On sites that are arable, forage production can be increased several times and the grazing season lengthened by several weeks by proper soil treatments and seeding to tame pasture species. However, pasture development on small unfenced tracts within extensive range areas usually results in severe overgrazing of the pasture with consequent underuse of native forage.

Old fields are highly important sources of forage for livestock throughout the Ozarks. The apparent need on most of these old fields is for more research to increase production by reseeding, fertilizing, and plant control. The primary range-management problem on old fields is to find out how to use them in connection with forested range and natural grassland to get efficient utilization of all these forage types.

Figure 7.--Examples of two common old field problems: Left, bare fields where increased herbage production is the greatest need and right, fields covered with broomsedge where the greatest problem is to replace the unpalatable species with palatable ones.



Glades

"Glades" in the Ozarks are naturally open sites characterized by very thin soils usually underlain by limestone (fig. 8). The most extensive glades occur in the White River drainage in southwestern Missouri. The section in which the glades occur is characterized by rough topography and highly variable soil conditions. Consequently, even where the glades are most extensive, the open grassland is intermingled with stands of timber. The total area of glade type in Missouri is estimated to be about 500,000 acres.

Perennial vegetation consists mainly of prairie grasses including big and little bluestem, purpletop, switchgrass, Indiangrass, prairie dropseed, and side-oats grama. Where grazing has been heavy, especially where the soil is very shallow, the perennials have been replaced by a dense stand of annual grasses, mostly Sporobolus neglectus Nash. and S. vaginiflorus (Torr.) Wood. Some of the glades, under the combined influences of heavy cattle grazing and fire prevention, have been invaded by redcedar so dense that the forage is almost gone.

The glades offer a possibility in the Ozarks for a permanent range-cattle industry. They are the most extensive natural grasslands in the Ozarks but their total area is not large. Unfortunately, the glades do not exist as a single uninterrupted range but as patches of from one to several hundred acres intermingled with a much larger acreage of forested land. Except for redcedar, the glades will not grow good trees and are not suitable for improved pasture. With good range management, which includes necessary woody-plant control, they will probably remain in grass indefinitely and will, therefore, provide a stable source of range forage. Carrying capacities are relatively high for native range and they can be grazed without serious detriment to the watershed.

Much of the glade-range area is not being used wisely or to the best advantage. On the national forests and on some private land much of the glade range is not fully used in average-to-wet years but the demand for forage exceeds the supply in dry years. Only the fact that the glade-range area is so small prevents it from being the most important Ozark range type.

Figure 8.--Typical glade range in Taney County, Missouri. After 3 years of drought and close grazing, the thin rocky character of the surface soil is clearly evident.

SUMMARY OF GENERAL DESCRIPTION AND BACKGROUND INFORMATION

The Ozark Region is a natural forest area. Still, the rural population is relatively high and the area supports about 1,000,000 cattle and more than 400,000 hogs. Farmers report that 85 percent of the value of farm products sold comes from livestock and livestock products. Part of this livestock income is derived from "range" livestock. Such use in the Ozarks is determined more by the needs, customs, and preferences of the local people than by land capabilities.

Ozark winters are neither too cold nor too long for range-livestock production and precipitation is adequate for ample forage growth. Exceptions to general climatic conditions occur where the soil is too shallow or the site is otherwise abnormally dry. Precipitation in the Ozarks is high enough for the production of improved pasture or tilled crops on arable sites and so high that trees tend to replace the grasses on most of the non-arable sites. However, better techniques of plant control may well provide for successful maintenance of permanent grass stands on some sites that are now forested.

The natural vegetation of the Ozarks is oak-hickory forest except where the soil is too thin for such trees to grow. The most abundant forage species are big and little bluestem and associated prairie species.

It is commonly recognized that forage production on Ozark forest range is related inversely to the density of the tree cover. Farmers who depend on livestock for most of their income feel that all tree reproduction is undesirable brush and have been in the habit of burning their ranges periodically to keep the trees from crowding out the grass.

Since many stockmen consider that burning is an essential range maintenance practice and since fire prevention and control are the first essentials of good forest management, the two interests conflict. It is largely a conflict between the farmer who lives on the land and must make his living from it and the professional foresters and others who can better afford to be concerned with long-time land-use objectives because their immediate income is not greatly affected by the current income from the land.

The Ozark rural population is so high and farms are so small that the average farmer cannot possibly make an adequate income solely from such extensive land uses as forestry and range-livestock production. Consequently, most arable land must be devoted to tilled crops or to improved pasture in order to provide more adequate farm incomes.

The only truly natural range areas in the Ozarks are those sites where the soil is too rough or rocky to till and too shallow to grow good trees. The greatest concentration of such thin-soiled land is the glade area along the White River in the southwestern Ozarks. Here the natural cover is grass, and range grazing promises to have a permanent place in the local economy.

Beef cattle are better suited than dairy cattle, sheep, or goats to make use of Ozark range because they can make good use of the rough, low-quality forage and because they require comparatively little care.

Although difficult to control on the range, hogs exceed cattle in numbers in heavily forested areas mainly because they feed on the oak mast rather than on grass and because the hog is a better animal for home use and a better investment for the poor farmer.

Even though 60 percent of the Ozark area is still in forest, these forests are only one-fifth fully productive and will require many years of protection and management before they can contribute substantially to the farm income. Since most Ozark farmers are in no position to wait until the forests improve, they prefer the quicker returns that can be obtained from the land by raising livestock.

MAJOR RANGE RESEARCH PROBLEMS

Practically all of the rough, untillable land in the Ozarks will grow grass. But on the forested range, high forage yields can be established and maintained only by persistent control of competing brush and trees. Even so, thousands of acres of Ozark forest land are used for range-livestock production. Much of the area is burned over frequently to maintain or increase forage yields. Ozark farmers favor livestock over timber because they can raise a calf or a shoat quicker than they can grow a saw log or a crosstie.

As indicated in the previous section, sharply defined Ozark forest and range types are usually caused by differences in depth and fertility of the soil, differences in topography, or differences in past use. The major Ozark range types of conditions considered in this analysis are the good and poor forested lands, cleared lands, and the glades.

The field for range research in the Ozarks is too broad to attack on all fronts at once. Consequently, the research field must be broken down into logical problems or units and priority assigned to these units. In the following analysis each problem or group of related problems is rated as to overall importance on the basis of the ultimate usefulness of its solution to the individual land user and to the number of people affected. However, the "usefulness" criteria by no means precludes essential fundamental studies that may be several steps removed from practical range management. Since the average Ozark farmer uses several if not all of the principal range types, almost any project has some potential utility for almost any Ozark range livestock operator.

EVALUATING FORAGE SPECIES AND RANGE TYPES

Reliable evaluations of forage species and range types are prerequisite to good range management. Range research must identify, describe, and determine the relative palatabilities and nutritive values, yields, and seasons of growth for the important forage species. An intimate knowledge is also needed of the extent, distribution, density, species composition, seasonal productivity, and usability of important range types for various classes of livestock. Such knowledge is needed to help the range manager set up sound, practical, range-management objectives. The evaluation of forage species and range types is highly important throughout the Ozark Region.

DETERMINING PROPER RATES OF STOCKING AND SEASONS OF USE FOR CATTLE

In the past, as each Ozark farmer saved the heifer calves from his milk cows or purchased stock to build up his herd, the total Ozark cattle population increased until the native forage could not adequately support it. Overgrazing became prevalent. Consequently, forage yields declined and the amounts of unpalatable grasses, weeds, and woody plants increased at the expense of preferred species. In some instances overgrazing by cattle has been so severe that tree reproduction has been damaged by browsing and trampling.

The first step toward wise range use is to work out utilization standards for the important forage species. Such standards for the individual species can then be used to develop standards of proper use for the various combinations of species and conditions. From these standards the researcher must then develop simple and readily usable methods that the farmer or land administrator can use to recognize or measure proper use, overuse, and underuse. Further interpretation of forage utilization and yield data is needed to determine the correct classes of stock, carrying capacities, and seasons of use for important range types and to work out practical range-management objectives and range livestock-handling systems that will insure proper use of the range forage.

Proper use and management are especially important on ranges that have been improved by removing woody plants or by reseeding. On ranges where woody plants are a problem, the forage should be managed in such a way that it is difficult for woody plants to become reestablished. On reseeded range, use should allow the preferred forage species to maintain their place in the forage stand. In either case the management objective should be to maintain or increase the desirable forage species and to prevent the establishment of undesirable species.

MANAGEMENT OF RANGES GRAZED BY HOGS

Closely akin to the preceding problem is that of determining rates of stocking, seasons of use, and methods of managing range hogs that will insure the greatest profit consistent with principles of good land use.

Much of the densely forested range of the Ozarks is probably better suited for range hogs than for range cattle. Unlike cattle, which feed mainly on grasses and other herbaceous plants that are

scarce in heavily wooded areas, range hogs rely mainly on the mast, which is a tree product. Hogs also assume importance because they are a more practical meat animal for home consumption, they usually offer a quicker return on the farmer's investment, and the farmer can buy a sow for much less money than he can buy a cow. Because of these and other factors, range hogs are more important to the farmer of the heavily wooded eastern Ozarks than to the resident of the more open, better grassed southwestern Ozarks.

Range-hog management affects not only the hog enterprise, but the land and the forest as well. Consequently, it is necessary to determine the damage hogs do to forest and site as well as the profit obtained from hogs Hogs also destroy forage that might otherwise be available for cattle. Since forestry is likely to continue to take precedence over hog raising in the forested range, the effects of hogs on tree reproduction, erosion, and soil are especially important. Range research should determine both the harmful and beneficial effects of range hogs on forest, forage, and site. Range-hog problems are most important on forested range.

INTEGRATING THE USE OF RANGE FORAGE WITH OTHER FORAGE RESOURCES

A common problem on all range land is how to integrate use of range forage with use of tame forage crops, improved pasture, hay, and grain for efficient livestock production.

Rainfall in the Ozarks is adequate and the frost-free season is long enough for ample forage production. Where herbaceous vegetation is not limited by competition from woody plants, herbage yields frequently exceed 2,000 pounds of dry matter per acre. But most Ozark forest ranges support a forest cover, and in these timber stands herbage yields average between 100 and 300 pounds per acre and seldom exceed 500 pounds.

Regardless of the amount of forage produced per acre, all Ozark forage is limited in quality because of the low mineral content of the soils on which it grows. Many nutritious range-forage species will not thrive on untreated Ozark soils and the low mineral content of these soils adversely affects the nutrient content of plants that will grow on them.

The value of Ozark range forage is also affected by the fact that most native Ozark range forage is produced by warm-season grasses such as little bluestem, Indiangrass, and purpletop, which produce ample, nutritious, green forage for a relatively short season. A primary need for better range livestock-production in the Ozarks is to lengthen the "green forage" period.

Another important problem is that of providing adequate nutrition in winter after the rainfall has leached most of the soluble nutrients from the native forage. Research should determine how to efficiently supplement range forage with mineral, vitamin, or protein supplements, or with farm-grown feeds.

The problem of integrating forage resources also involves the problem of using range forage to supplement farm-forage resources. This aspect of range management became particularly important during the 1952-1954 drought in Missouri. As farm pastures dried up and reserves of stored feed ran low, more and more cattle were turned out on the range.

Experience during the drought years has raised a question as to the chief value of forest range. In good years it will maintain cattle but is not highly regarded for putting on weight. In dry years reserve range forage provides an economical means of maintaining the cattle herd. In some parts of the Ozarks the range may fit in as a place for maintaining the breeding herd in winter or other periods of feed shortage.

Integration problems are highly important on all types of range. However, more knowledge of forage species, rates of stocking, and seasons of use on each range type should be accumulated before starting any direct studies on integration problems.

DETERMINING GRAZING-FORESTRY RELATIONSHIPS

Range research on forested range is needed not only to solve problems of range management but also to help resolve some of the controversy between those who are interested in grazing and those who are interested in forestry. The amount of damage cattle do in the forest is debatable. Range research can help determine when and how much damage range cattle do to tree reproduction and the soil and what conditions contribute to such damage.

To help meet the goal of obtaining the maximum income that is consistent with good land use, range research also should determine to what extent and under what conditions range forage may have to be undergrazed in order to prevent damage to tree reproduction, watershed, and other values. At the same time, research should also determine whether or not there are situations that justify temporary overgrazing because it fulfills a pressing economic need.

Besides running cattle in the woods to harvest whatever forage happens to grow incidental to timber production, there is the possibility of modifying forest management deliberately to create a more open forest stand and increase forage production. Range research should determine the feasibility of using such practices as heavier cutting, moderate browsing by goats or deer, and occasional prescribed burning to keep forests open and prevent declines in forage quality and yield.

Every Ozark farmer must decide which of his wooded land, if any, he will leave in forest and which he will convert to grass. Some Ozark sites are clearly capable of producing commercial timber in a reasonable period of time, some are definitely submarginal, and some belong in an in-between classification. All types of sites can be made to grow grass but it is usually harder for grasses to compete with trees on the good timber sites than on the poor timber sites. Regardless of the type of land, the farmer's decision will usually favor the use that promises the greatest immediate income with the least effort, investment, and development of new management skills. If the use selected happens to be one that is good for the land it is usually because good land use results in better income with less work rather than for the sake of good land use itself. Since private owners control more than 90 percent of the forest land in the Ozarks it is in the interest of conservation to encourage those land uses that are acceptable from the standpoint of conservation but which also provide immediate tangible benefits for the landowner. If timber cannot provide the farmer's needs he must turn to some other crop or leave the land. Research is needed to determine the feasibility of converting unproductive Ozark forest land to range.

INCREASING GROWING CAPACITIES BY RESEEDING AND SOIL TREATMENT

The natural forage on Ozark range is not ideal for range cattle. Little bluestem, big bluestem, and other grasses, which make up the bulk of the native forage, are warm-season grasses. Since they begin growing late in the spring and dry up quite early in the fall, they furnish palatable and nutritious green forage for a comparatively short time. Grasses are needed that will start growing early and stay green late into the fall. The native forage also is conspicuously deficient in palatable forbs. Hence, non-grasses, preferably legumes, which will provide palatable high protein forage, are also needed.

A very important range problem, especially on private land, is that of developing improved pastures on cleared areas that are large enough and accessible enough to justify fencing, water development, and management. Some usable techniques for this type of development have already been worked out, but much remains to be done.

Since improved-pasture development is expensive, a less intensive approach to range improvement is needed. Perhaps the goal should be to use species that can be established and maintained without heavy applications of lime and fertilizer. Methods for increasing forage yields on old fields inexpensively and without unduly complicating range management are urgently needed especially for old fields that are used as integral parts of rather extensive and variable forest ranges.

CONTROLLING WOODY PLANTS WITH CHEMICALS AND MACHINERY

Herbicides and machines are taking the place of some of the chopping, girdling, goating, and burning for woody-plant control. Ammate, 2,4-D, and 2,4,5-T, and mixtures of 2,4-D and 2,4,5-T are the chemicals most frequently used in the Ozarks. For clearing small patches where there is a wide range of tree sizes and several species, individual tree treatments are commonly used. For low, sprout stands of relatively uniform height, power sprayers mounted on trucks or tractors probably are most satisfactory. Airplane spraying has been tried for large scale work but results have been variable. If used properly, herbicides greatly reduce the need for and cost of follow-up treatments in brush and tree control, but they will not consistently kill 100 percent of the treated plants even with thorough application. Herbicides are good plant-control tools, but they must be used properly to be effective and there is need for much improvement.

More information is needed on carriers, concentrations, rates and seasons of application, methods and equipment, and even on development and appraisal of new herbicidal compounds. Control of woody plants is one of the most urgent range problems in the Ozarks and there is a great demand for cheaper and more effective control methods.

Bulldozing is one of the quickest ways to clear wooded or brushy land. It leaves the land looking clean, smooth, and in good condition for seeding. The bulldozer usually uproots trees larger than about 3 inches in diameter, leaving no stump to sprout. But many trees smaller than 3 inches in diameter are merely pushed over or are broken off above ground. Such stumps almost invariably sprout and require follow-up treatment.

The role of improved range management in connection with woody-plant control is particularly important. The Ozark rancher needs to know how to manage his improved range not only to prevent destructive use of the forage but also to discourage the regrowth of woody plants. Using the right kinds and numbers of livestock and grazing at the right time of year can reduce the cost and frequency of retreatment. Range research should work out stocking schedules that will help keep Ozark rangeland free of unwanted woody vegetation. This problem is discussed in more detail in the next section.

CONTROLLING WOODY PLANTS WITH GRAZING MANAGEMENT AND FIRE

Most Ozark ranges are all or partly forested. Nevertheless, practically all Ozark sites will grow dense stands of tall prairie grasses if the forest stand is removed or kept open. Without control of woody plants, most forests become so dense that forage production is negligible. Even some of the thin-soiled glade ranges are being invaded by redcedar, winged elm, and associated drought-tolerant trees.

The early Ozark rancher did not have the necessary information, materials, or techniques for growing improved pastures, and population pressure did not require intensive land use. His principal means of increasing grass production was to remove brush and trees. His methods consisted primarily of cutting small trees and girdling large trees followed by browsing with goats, burning, or both (fig. 9). Because of their widespread use, their detrimental effect on the site, and their direct and indirect effects on land use, browsing and burning are discussed in some detail.

Goats in the Ozarks are valued not so much for the milk or mohair they produce as for their browsing habit which makes them useful for controlling hardwood sprouts. The ordinary "goating" operation (killing sprouts by severe overbrowsing with goats) involves killing or removing all existing woody top growth by some combination of logging, girdling, chopping, and burning, after which the area is enclosed in a goat-proof fence and the goats are turned in to browse on the sprouts Browsing with from 1 to 4 goats per acre year-long for about 3 years is a popular but expensive and destructive sprout-killing method.

Despite the obvious disadvantages of goating as now used, there is a real basis for believing that <u>proper</u> manipulation of livestock classes and numbers may provide some measure of woody-plant control. According to early writers, much of the Ozark Region was originally rather open forest with abundant grass on

the forest floor between the trees. Deer were abundant. Since deer are natural browsers, it is conceivable that the high deer population in pre-settlement days was sufficient to help keep tree reproduction from filling in between the big trees and crowding out the grasses and forbs in the mature forest stands.

A modern example of the effect of a high deer population on the vegetation in the southwestern Ozarks is Skaggs Ranch in Taney County. This ranch, which was initially set up as a private game park, has not been burned over for at least 20 years and has been enclosed by deer-proof fence most of the time during the past 50 years. The deer population inside Skaggs' fence has been consistently high. In fact, starvation mortality has occurred from time to time. More recently, starvation losses have been reduced by winter feeding and reduced numbers.

The forest stands on Skaggs Ranch are rather open and are made up mostly of post oak, black oak, and associated hardwoods ranging upward in size from about 4 inches d.b.h. Eastern redcedar is the only commercial tree that is reproducing itself. It is represented by numerous 1- to 6-foot trees and small seedlings beneath the old hardwood overstory and by patches of larger trees at scattered locations. Protection from fire in recent years and low palatability for deer have permitted cedar reproduction to survive.

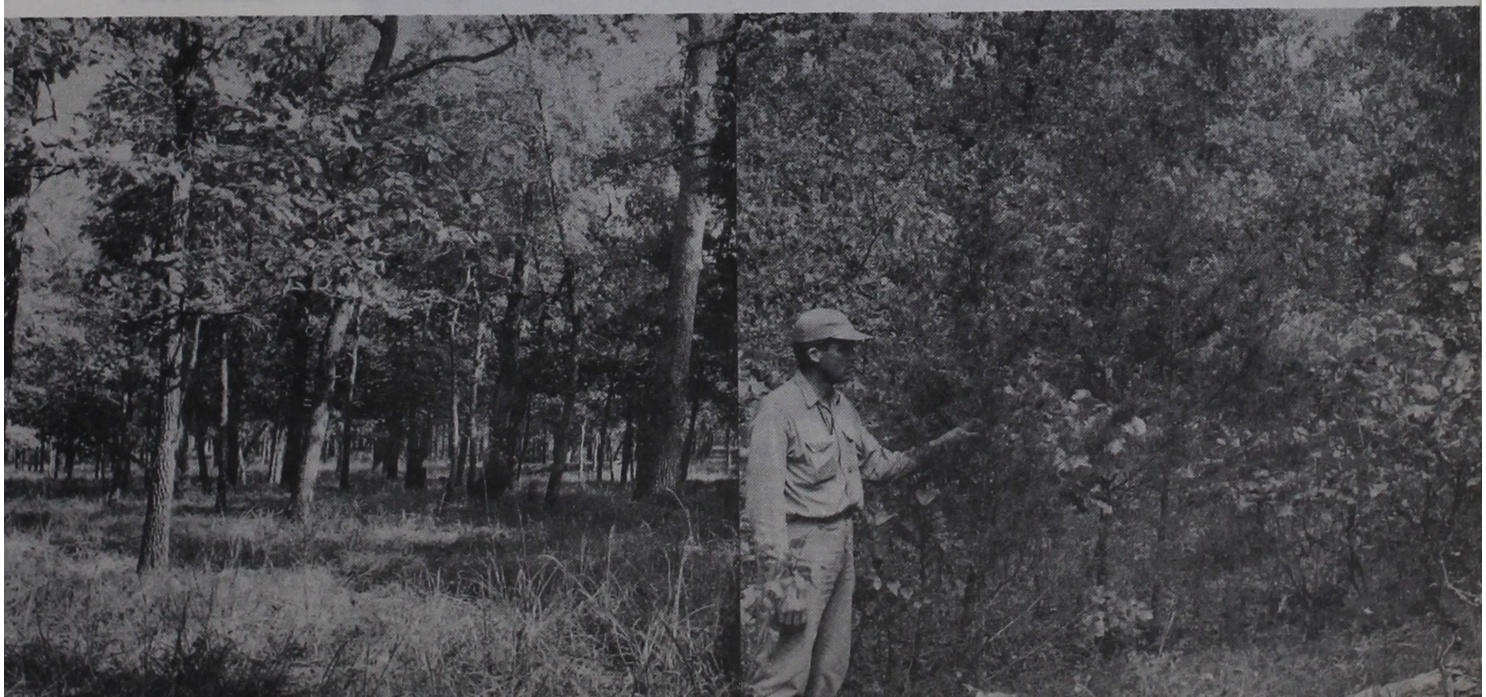
Figure 9.--The ax and the goat have shortcomings as brush-control tools. Left, post oak, like most Ozark tree species, will continue to sprout after repeated chopping and browsing; right, clearing by chopping and goating usually leaves the land in poor condition and eliminates only a part of the brush.

The herbaceous ground cover on Skaggs Ranch is dominated by little bluestem, purpletop, Indiangrass, and associated prairie grasses (fig. 10, left). Such forbs as do occur almost invariably are so small or so well concealed in the grass that they have escaped browsing. Outside Skaggs' fence the grass cover is sparse but forbs and tree reproduction are abundant (fig. 10, right).

If deer are responsible for the absence of brush and tree reproduction on Skaggs Ranch, it seems logical to hope that a similar result might be obtained on range land with goats and sheep. One question that arises, of course, is, will sheep, goats, deer, or any other browsing animal do an effective brush-control job without at least occasional overstocking?

Many Ozark ranchers believe that the way to maintain forage stands in the Ozarks is to burn often enough to keep the tree reproduction from crowding out the grass. Certainly without persistent brush control of some sort, most Ozark sites sooner or later develop a hardwood forest cover in which forage production is very low.

Figure 10.--Effects of persistent overstocking with deer: Left has been heavily browsed by deer for most of the time during the past 50 years, has few forbs, no visible hardwood reproduction, and a dense grass cover; right just across the fence has abundant tree reproduction but very little grass.



Large trees usually do not sprout after the tops are killed but small trees sprout profusely and vigorously. This difference in the sprouting ability of large and small trees accounts for a lot of the differences in the relative success of tree-killing projects (fig. 11). Before burning and cutting, the forest stand shown in figure 11A was composed almost entirely of large trees with very few trees in the sapling and reproduction classes. Trees that were not killed by the fire or harvested beforehand were cut or girdled. This area will probably remain relatively open for several years. Before burning, the area shown in figure 11B was a stand with lots of small sprouts and saplings. Resprouting quickly eliminated any forage increases that may have resulted. On both areas all commercial timber was removed or destroyed. On the first, forage production may increase sufficiently and over a long enough period to be worthwhile. On the second, it almost certainly will not.

Research may have to develop range-management systems that include periodic changes in the class of livestock and even occasional "prescribed overstocking" with certain animals in order to control woody plants and to maintain a good forage cover.

Grazing systems that will encourage forage plants and discourage woody plants are badly needed on all types of Ozark range. Such grazing systems are especially needed in conjunction with chemical and mechanical control. Efficient plant control and good range management together can do much to improve the lot of the average Ozark farmer or stockman.

MANAGING LIVESTOCK ON THE RANGE TO REDUCE LOSSES FROM POISONOUS PLANTS, PARASITES, AND DISEASES

Poisonous plants, ticks, lice, fleas, warbles, screw worms, stomach worms, and other common cattle parasites undoubtedly are responsible for much economic loss to Ozark stockmen. Likewise, blackleg and shipping fever in cattle and hog cholera are common livestock diseases. Conventional parasite-control programs that require frequent dipping, spraying, or internal medication usually are difficult to administer under range conditions because the facilities for controlling and handling the cattle are inadequate. Range researchers should cooperate with specialists in working out practical methods for controlling these pests on the range.

Many poisonous plants grow on Ozark ranges. Normally, such plants are not eaten and cause little trouble. However, research should determine what conditions are conducive to livestock losses due to poisonous plants and work out practical management measures to avoid or prevent such losses.

(A)

(B)

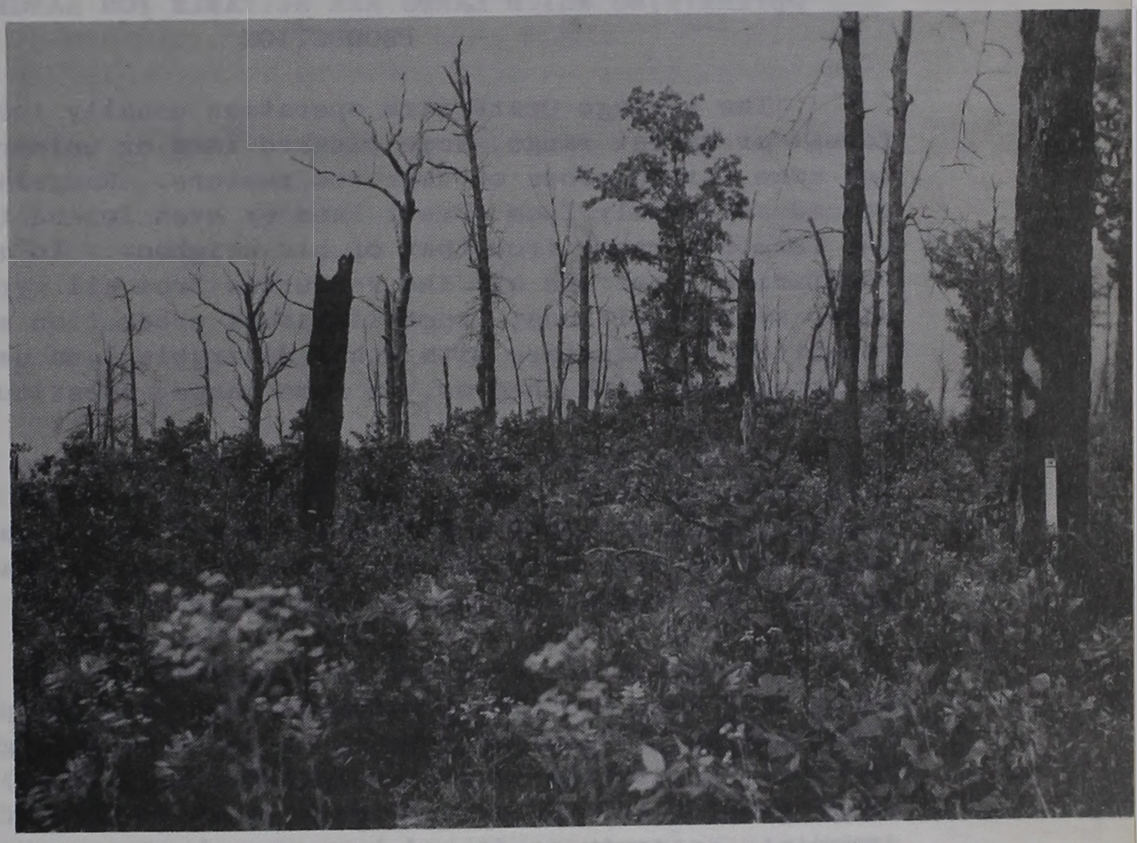


Figure 11.--Burning and cutting do not always have the same effect: (A) is fairly free of sprouts and may remain open a long time because the original timber stand contained very few small trees. If any range benefits were obtained on (B), resprouts from the stumps of numerous small trees soon eliminated them.

The most spectacular symptom of nutritional disease in the Ozarks is "Acorn Calves." Acorn calves are malformed at birth and a high percentage are born dead or die soon after. The origin of the name "Acorn Calves" lies in the belief that they occur mainly in high acorn crop years when the cows feed almost exclusively on acorns during part of the gestation period. Livestock experts at the University of Missouri suspect that "Acorn Calves" are the result of a vitamin A deficiency. The validity of this hypothesis should be determined.

Parasite- and disease-control problems and poisonous-plant problems are rated as medium in overall importance. Nevertheless, every possible opportunity will be taken to cooperate with and assist persons and agencies who aretrained and equipped to tackle such problems.

DETERMINING WHICH LANDS ARE SUITABLE FOR RANGE-LIVESTOCK PRODUCTION

The average Ozark farm operation usually includes some forest or forest range, some cleared land or unimproved pasture, and some tilled crops or improved pasture. Rangeland is seldom fenced separately from forest land or even fenced to separate the farmer's range from that of his neighbor. To make a living the farmers must use all the resources from all types of land. Under such conditions, range-livestock production should not be permitted to interfere with other desirable land uses but should be integrated with them or, in some cases, substituted for them.

On many Ozark areas, range and forestry are somewhat complementary in that range-forage yields are highest where the timber stands are open and in poor condition. In such stands range cattle will provide some income from land that offers no prospect for immediate income from forestry.

The principal problems in integrating range grazing with other land uses are (1) to determine the rightful place of range livestock in the general economy of the area in light of needs of the local people and land-use capabilities, and (2) to integrate range grazing with other land uses to minimize conflicts between immediate economic needs and long-time land-use objectives. The overall objective of the range research program is to make range livestock contribute as much as possible to the economy without impairing the value of the site for grazing or other uses.

It is relatively easy for research to develop or recommend practices that represent an improvement in land use. But, solutions to land-use problems are apt to be ignored by the farmer unless they provide immediate economic benefits. If there is an urgent need for immediate income that cannot be supplied by forest products, it may be desirable to convert some forest to grass. By growing the timber and grass on separate tracts, the conflicts of multiple use can be avoided.

The problem of finding the proper place of range and range livestock in the Ozarks is perhaps the most important of all. Basically it is a problem in land use. However, it is such a broad problem that it can be solved only by combining the solutions of numerous technical problems in forestry, grazing, and cropland management.

THE IMMEDIATE RANGE RESEARCH PROGRAM

It is obvious that a full-scale research program would be required to do justice to all of the range problems in the Ozark Region. The limited range research program at the Central States Station can do effective work on only a small part of the research job that needs to be done. Other parts of the job can be handled cooperatively with the University of Missouri, the Agricultural Research Service, and other interested agencies. But, even when the contributions of all agencies are combined, the task force is not equal to the task. Consequently, problems must be arranged in order of decreasing priority or importance.

The present research program consists mainly of high priority research problems. In a few cases studies are in progress on problems that are only of medium importance. Most of these studies are nearing completion. Some changes in the range research program of the Forest Service are being made to conform to changes in responsibility brought about by the reorganization of the U. S. Department of Agriculture. In general the Forest Service will continue to have primary responsibility for research in grazing management not only on forest ranges but also on ranges improved by reseeding or by the chemical or mechanical control of woody plants. Management of these improved or converted lands is especially important in view of the current interest in converting forested land to range in the Ozarks. The Agricultural Research Service is continuing the work started by the Forest Service in woody-plant control and is anxious to cooperate in any program of research that will provide information about values of such converted land for grazing. Emphasis in the range program will be on securing information that will help decide which land may be profitably cleared for grazing and how such converted land should be managed to insure continued high production of forage and a minimum of follow-up treatment to prevent reinfestation by woody plants.

Attached is a summary table that lists the 10 general groups of range research problems that have been discussed. Each group of problems is rated as to overall importance on each of the major range types. For this purpose forest range is divided into "good" and "poor" forest land.

TABULAR SUMMARY OF IMPORTANT RANGE RESEARCH PROBLEMS AND STUDIES IN PROGRESS

Important general types of range research problems in the Ozark Region of Missouri	Overall Importance[1] Forest Good	Forest Poor	Old Field	Glade	Studies in Progress[2] Forest Good	Forest Poor	Old Field	Glade
1. Evaluating forage species and range types	M	H	M	M	F	F		F
2. Determining proper rates of stocking and seasons of use for cattle	M	H	M	H				
3. Management of range used by hogs	M	M	N	N				
4. Integrating the use of range forage with other forage resources	M	H	H	M				
5. Determining grazing-forestry relationships	H	H	L	M	F	F		F
6. Increasing grazing capacities by reseeding and soil treatment	L	M	H	L			I[3]	
7. Controlling woody plants with chemicals and machinery	L	H	M	M	F[3]	F[3]	I[3]	
8. Controlling woody plants with grazing management and fire	L	M	L	M				F
9. Managing range livestock on the range to prevent losses from poisonous plants, parasites and diseases	M	M	M	M				
10. Determining which lands are suitable for range-livestock production	M	H	M	M	(All studies in progress contribute to the ultimate solution of these land-use problems)			

LEGEND

1/ (Overall Importance): High--"H", Medium--"M", Low--"L", Not Applicable--"N".
2/ (Studies in Progress): Formal--"F", Informal--"I".
3/ ARS is assuming leadership in these fields.

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